



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 1/8

MEDICINE FACULTY

MEDICAL STUDY PROGRAM 0912.1. MEDICIN

Department of Anatomy and Clinical anatomy

APPROVED

at the meeting of the Commission for Quality Assurance and Curriculum Evaluation faculty of Medicine

Protocol Nr. 1 from 16.09.21

President _____

Suman Serghei _____

APPROVED

at the meeting of the Faculty of the 2 Medicine Council

Protocol Nr. 1 from 21.09.21

Dean of the Faculty of Medicine 2

Dr. șt. med. conf. univ

Mircea Bețiu _____

APPROVED

at the Department of anatomy and clinical anatomy

Protocol Nr. 2 from 1.09.22

Chief of the department,

dr. hab. șt. med., prof. univ.,

Catereniuc Ilia Catereniuc Ilia

CURRICULUM DISCIPLINE REGENERATIVE MEDICINE

Integrated studies

Course type: **Optional discipline**

Curriculum developed by the group of authors:

Nacu Viorel, dr. hab., prof. univ.

Suman Serghei, dr. hab., prof. univ.

Chișinău, 2022



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 2/8

I. PRELIMINARIES

✓ **The discipline general presentation: the place and role of the discipline in the formation of specific competences of the vocational/specialty training program:**

- Regenerative medicine is a specialty that applies the principles of engineering and life sciences in the manufacture of biological substitutes to maintain, restore or improve the function of organs and tissues in the human body.
- Due to its highly interdisciplinary nature, tissue engineering includes concepts from a variety of fields, such as cell biology, microfabrication, robotics, and science materials to design spare parts in the human body (e.g., bones, cartilage, heart valve, bladder, etc.). Also known as human tissue engineering.
- The development of cellular and molecular biology, with great technical and scientific achievements, has made the possibilities to restore or improve the function of organs and tissues damaged by disease or trauma. Organ and tissue transplant surgery from donors.

✓ **Mission of the curriculum (goal) in professional forming:**

- The basic mission of regenerative medicine is research with human embryonic stem cells, as well as in different animal models and the purpose of knowledge.
- The basic mechanisms of initial development and organogenesis.
- Application of stem cell-derived cell lines in diseases (regenerative medicine) in which there are cell losses (degenerative diseases).
- 21st Century Medicine is as REGENERATIVE MEDICINE.

Languages: English, Romanian, Russian, French.

Beneficiaries: 4th year students, Medicine 1 and 2 faculty, specialty Medicine

● ADMINISTRATION OF THE DISCIPLINE

The discipline code		S.08.A.072.4	
Name of the discipline		Medicină regenerativă	
Responsible (s) for the discipline		dr. hab. șt. med., prof. univ., Nacu Viorel	
Year	IV	Semestrul	8
The total number of hours, include:			30
Lectures	10	Lucrări practice/ de laborator	10
Seminars	-	Lucrul individual	10
Evaluation form	E	Number of credits	1

● TRAINING OBJECTIVES IN THE DISCIPLINE

At the level of knowledge and understanding:

- To know the legislation of the Republic of Moldova and the EU in the field of cell and tissue transplantation.
- To know the ethical issues in cell and tissue transplantation.
- Possess knowledge about the types of stem cell proliferation capacity.
- Define stem cell sources.
- To define and theoretically relate the principles of tissue engineering.
- To identify the capabilities and possibilities of gene therapy.
- To know the ways of accomplishing the cell therapy.

✓ *At the application level:*

- Possess the application of knowledge.
- Demonstrate the selection of nutrient media for cell culture.
- To solve situation problems.
- To identify the necessary equipment for regenerative medicine.
- To identify cell and tissue grafts for tissue engineering.
- To argue the usefulness of cell therapy for modern medicine.
- To identify diseases in which regenerative medicine can be used.
- To know the basics of working in a regenerative medicine laboratory.

✓ *At the integration level:*

- To appreciate the importance of Regenerative Medicine in the context of integration with other related medical disciplines.



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția:	09
Data:	08.09.2021
Pag. 3/8	

- To approach creatively the problems of practical and fundamental medicine.
- To deduce the interrelationships between Regenerative Medicine and clinical disciplines.
- To have skills in implementing the knowledge obtained in Regenerative Medicine in clinical disciplines.
- To be apt in the evolution and objective self-evaluation of the knowledge obtained in the field.
- Be able to assimilate new knowledge and achievements in regenerative medicine and its components.
- To make decisions in assessing the optimal methods of inoculation of cell grafts.

IV. PREVIOUS CONDITIONS AND REQUIREMENTS

Regenerative medicine is an emerging field of biotechnology, represented by state-of-the-art techniques aimed at anatomically restoring damaged or degenerated tissues and their functional rebalancing. For the good acquisition of the discipline, it is necessary the thorough knowledge in the field of anatomy, embryology, biology, and molecular medicine, obtained during the university, postgraduate studies, and continuous improvement of the specialists in the field.

To master the discipline, it is necessary to have a thorough knowledge in the field of anatomy, embryology, basic elements of surgical techniques obtained during university, postgraduate studies, and continuous training of specialists in the field. The fourth-year student requires the following:

- knowledge of the language of instruction.
- skills confirmed in science at the level of the first year (descriptive anatomy).
- digital skills (use of the Internet, processing of documents, electronic tables and presentations, use of graphics programs);
- ability to communicate and work in a team.
- qualities - tolerance, compassion, autonomy.

V. TOPICS AND ORIENTATIVE DISTRIBUTION OF HOURS

A. Lectures (Courses)

Nr. d/o	Topic	Lect ures	Prac tical	Indiv idual work
1.	1.1. Introduction. Regenerative Medicine - concept, content, task. 1.2. History. Regenerative medicine as a science. Components of regenerative medicine. Basic strategies of regenerative medicine: cell therapy and tissue engineering. 1.3. Law and medical ethics aspects of regenerative medicine. 1.4. International and national legislation in the field of Regenerative medicine (tissue engineering products are drugs or other forms of additional information).	2	2	2
2.	2.1. Stem cells. Stem cells types. 2.2. Mesenchimale and hematopoietic stem cells. 2.3. Embryonic, fetal, germinal and adult stem cells. 2.4. Stem cells characterization, proliferation and differentiation capabilities. Sources for stem cells obtaining.	2	2	2
3.	3.1. Gene therapy. Perspectives of the utilization of genetically modified cells for therapeutic goals. 3.2. <i>Ex vivo</i> gene therapy and <i>in vivo</i> (gene cell therapy). 3.3. Gene therapy of the monogenic diseases (inherited) and multifactorial (common). Stable and temporary expression of therapeutic genes. 3.4. Potential risks of gene therapy (insertion mutagenesis, immune reactions, etc.). The utilization of stem cells as vectors for directed transportation. 3.4. Celulare vaccines.	2	2	2
4.	4.1. Tissue engineering - as an interdisciplinary field, including biology, medicine and technical sciences, that studies the creation <i>in vitro</i> of tissue and organ equivalents using the principles of cell culture transplantation biocompatible carrier. 4.2. The preparation of biomaterials is on the consideration of the physicochemical, biomechanical, engineering properties. 4.3. Aspects of engineering design, biomaterial systems involving in 2D and 3D. 4.4. Nanotechnologies in the new 3D structure design for tissue engineering and regenerative medicine. 4.5. 3D organ and tissue printing, actuality and perspectives.	2	2	2
25.	5.1. Regenerative medicine applied in clinical practice 5.2. Tissue engineering of muscular-skeletal disorders, present state. Definitions of the bone and cartilage restoration or repair. Bone grafts, bone replacements. 5.3. Cardiovascular sistem regenerative medicine. Types of cells and methods of	2		



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 4/8

delivering.			
5.4. Cellular therapy in the central nervous sistem discordies, liver diseases, diabetus miletius, etc.		1	2
5.5. Cellular immunotherapy for cancer and other chronic diseases. Cell vaccines. Transplants - autologous, allogenic, xenogenic			
5.6. Experimental Medicine. Planning of experimental research <i>in vitro</i> and <i>in vivo</i> (on animals). Choosing suitable animal. Working with experimental animals, anesthesia, preparation for surgery, care. Methods and requirements for euthanasia.			
Examen		1	
Total		20	

VI. REFERENCE OBJECTIVES AND CONTENT UNITS

Obiectives	Content units
Chapter 1.	
1.1. How to work with cell cultures.	Cell - Fundamental constituent of living organisms, consisting of membrane, cytoplasm, and nucleus, representing the simplest anatomical unit
1.2. Principles of preparation of sterile media and solutions.	Principle - Fundamental element, idea, basic law on which a scientific theory is based.
1.3. Working with hood with laminar air flow, incubator with SO ₂ .	Culture medium - food provided to artificially grown organisms and which must contain all the substances necessary for their life.
1.4. Methods of cryopreservation of cells cultures.	
Chapter 2.	
1.1. Principles of immunocytochemistry and immunohistochemistry. Histochemical methods for the determination of different cell and tissue types.	Histochemistry - A branch of histology that studies, with different dyes, the chemical structure of cells and tissues of the body.
2.2. Working with the Phase Contrast Inverted microscope (2006). Obtaining and processing images in electronic form.	Microscope - an optical device built based on a lens system, which greatly magnifies the image of very small objects. Image - sensory reflection of an object in the human mind in the form of sensations, perceptions, or representations.
Chapter 3.	
3.1. Principles of flow cytometry. Counting cells with different cytophenotype in mixed populations, analysis of histograms obtained using flow cytometry.	Principle - the fundamental element, idea, basic law on which a scientific theory is based. Cell - fundamental constituent of living organisms, consisting of membrane, cytoplasm, and nucleus, representing the simplest anatomical unit Cytometry - counting or measuring blood cells.
Chapter 4.	
4.1. Working principles of the cell sorter. Separation of cells with different cytophenotype using a sorter.	Principle - the fundamental element, idea, basic law on which a scientific theory is based. Separation - the act of separating and its result; separation, isolation; differentiation. Phenotype - a set of traits and characteristics that are visibly manifested in an individual and which is determined by the hereditary basis and environmental conditions.
Chapter 5.	
5.1. Planning of <i>in vitro</i> and <i>in vivo</i> (animal) experimental research. Choosing the right animal model.	To make a plan; to organize and lead on the basis of a plan; to organize an activity, drawing up the plan according to which to carry out its different phases.
5.2. Working with experimental animals, anesthesia, preparation for surgery, care.	<i>In vitro</i> - Outside the living organism; in the lab. <i>In vivo</i> - Inside the living organism.
5.3. Methods and requirements for euthanasia.	Methods - (systematic) way of research, knowledges and transformation of objective reality.

VII. THE PROFESSIONAL COMPETENCES (SPECIFIC (CS) AND TRANSVERSAL (CT) AND DISCIPLINE FINALS:

✓ THE PROFESSIONAL COMPETENCES:

- Knowledge, understanding and use of language specific to Medicinei regenerative;



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 5/8

- Knowledge and understanding of the organization of ethical issues in cell and tissue transplantation.
- Explaining and interpreting knowledges about the types of stem cells and their proliferation capacity.
- Knowing the definition of stem cell sources.
- Sense and possibilities of Gene therapy.

✓ TRANSVERSAL COMPETENCES:

- Improving decision-making autonomy;
- Forming your personal attitude
- Ability to social interaction, group work with different roles
- Fitting in interdisciplinary projects, extracurricular activities,
- Improvement of dissection skills
- Improving digital skills
- Developing different learning techniques to learn
- Selection of digital materials, critical analysis and conclusions.
- Presentation of individual scientific projects

✓ DISCIPLINE FINALS:

- To know the particularities of organizing regenerative medicine;
- To know the particularities of the legislative and ethical organization;
- To know the basics and the practical role of regenerative medicine between surgical disciplines.
- To be able to evaluate the place and role of regenerative medicine in the preclinical and clinical training of the student-doctor;
- To be competent to use the knowledge and methodology of regenerative medicine;
- To be able to implement the knowledge gained in the research activity;
- To be competent to use critically and confidently the scientific information obtained using new information and communication technologies.

• VIII. THE STUDENT'S INDIVIDUAL WORK

Nr.	The expected product	Implementation Strategies	Evaluation criterias	Deadline
	<i>Working with information sources:</i>	Read the lecture or the material in the manual to the theme carefully. Read questions on the subject, which require a reflection on the subject. To get acquainted with the list of additional information sources on the topic. Select the source of additional information for that theme. Reading the text entirely, carefully and writing the essential content. Wording of generalizations and conclusions regarding the importance of the theme / subject.	Ability to extract the essentials; interpretative skills; the volume of work	During the semester
	<i>Working with the practical lessons book:</i>	Transcribing the various tasks in the practical lesson with solving them by associating the drawings to the explicit text. Analyze the information from the pictures of the lecture topic and the manual. Solving consecutive tasks. Formulate conclusions at the end of each lesson. Verify the final lessons of the lesson and appreciate their achievement. Selection of additional information, using electronic addresses and additional bibliography.	Workload, problem solving, ability to formulate conclusions	During the semester
	<i>Apply different learning techniques:</i>	Association of theoretical training with the development of dissection skills, learning of surgical nodes, participation in the work of the department for medical and surgical skills	Volume of work, degree of insight into different subjects, level of scientific argumentation, quality of conclusions, elements of	During the semester



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 6/8

Nr.	The expected product	Implementation Strategies	Evaluation criterias	Deadline
			creativity, demonstration of understanding the problem, formation of personal attitude	
	Working with online materials:	Self-assessment by viewing on-line resources, studying on-line materials on the SITE department, expressing your own opinions through forum and chat	Number and duration of SITE entries, self-evaluation results	During the semester
	Preparing and supporting presentations / portfolios:	Selection of the research theme, establishment of the research plan, setting the terms of realization. Establishing PowerPoint project / theme components - theme, purpose, results, conclusions, practical applications, bibliography. Colleagues reviews. Teacher reviews	The volume of work, the degree of penetration in the essence of the project theme, the level of scientific argumentation, the quality of the conclusions, the elements of creativity, the formation of the personal attitude, the coherence of the exposure and the scientific correctness, the presentation,	During the semester

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-EVALUATION

• Teaching methods used

The optional module Regenerative Medicine is taught in the classic way: with lectures and practical works. Lectures are read by course holders. In the practical work, students study based on the existing devices and equipment in the Laboratory of Tissue Engineering and Cell Cultures, watching movies (including Regenerative medicine techniques), participating in demonstrations of anesthesia, obtaining stem cells from experimental animals.

When teaching the optional subject Regenerative Medicine, different teaching methods and procedures are used, oriented towards the efficient acquisition and achievement of the objectives of the teaching process. In the theoretical lessons, along with the traditional methods (lesson-exposition, lesson-conversation, lesson of synthesis) modern methods are also used (lesson-debate, lesson-conference, problematic lesson). In the practical works are used forms of individual activity, frontal, in group, virtual laboratory works. For the deeper acquisition of the material, different semiotic systems (scientific language, graphic and computer language) and teaching materials are used. Information Technology is used in extracurricular lessons and activities - PowerPoint presentations, online lessons.

• Recommended learning methods

- **Observation** - Identification of characteristic elements of biological structures or phenomena, description of these elements or phenomena.
- **Analysis** - Imaginary decomposition of the whole into components. Highlighting the essential elements. Studying each element as part of the whole.
- **Schema / figure analysis** - Selection of required information. Recognition based on knowledge and information selected structures indicated in the drawing, drawing. Analysis of the functions / role of recognized structures.
- **Comparison** - Analysis of the first object / process in a group and the determination of its essential features. Analysis of the second object / process and the determination of its essential features. Comparing objects / processes and highlighting common features. Comparing objects / processes and determining differences. Establishment criteria for decommissioning. Formulation of conclusions.
- **Classification** - Identification of the structures / processes to be classified. Determining the criteria on which classification is to be made. Distribution of structures / processes by groups according to established criteria.
- **Schematic drawing** - Selection of elements to be included in the schematic. Playing the Elements Selected by Different Symbols / Colors and Indicating Their Relationships. Wording of an appropriate title and legend of the symbols used.
- **Modeling** - Identify and select the elements needed to model the phenomenon. The imaging (graphical, schematic) of the phenomenon studied. Realizing the phenomenon using the developed model. Formulation of conclusions, deduced from arguments or findings.
- **Experiment** - Formulation of a hypothesis, based on known facts, on the process / phenomenon studied. Verifying the hypothesis by performing the processes / phenomena studied under laboratory conditions. Formulation of conclusions, deduced from arguments or findings.

• Applied didactic strategies / technologies (discipline specific);



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 7/8

„Brainstorming”, „Multi-voting”; „Round table”; „Group interview”; „Clinical case”; „Creative Controversy”; „Focus group technique”, „Portfolio”.

Virtual Practices

• **Methods of assessment (including an indication of how the final grade is calculated).**

☐ **Current:** front and / or individual control through

- (a) applying docimological tests,
- (b) solving problems / exercises,
- (c) analysis of case studies
- (d) performing role-plays on the topics discussed.
- (e) control work

✓ **Final:** exam

The final mark will consist of the average score from three control works and a six-month scientific project (share 0.5), the final test sample in computerized system (share 0.5).

The average annual mark and the marks of all the final exam stages (assisted by computer, test) - all will be expressed in numbers according to the scoring scale (according to the table), and the final mark obtained will be expressed in two decimal places to be passed in the note book...

Scoring scale

THE INTERMEDIATE NOTES GRILL (annual average, grades from the exam stages)	National scoring scale	EquivalentECTS
1,00-3,00	2	F
3,01-4,99	4	FX
5,00	5	E
5,01-5,50	5,5	
5,51-6,0	6	
6,01-6,50	6,5	D
6,51-7,00	7	
7,01-7,50	7,5	C
7,51-8,00	8	
8,01-8,50	8,5	B
8,51-9,00	9	
9,01-9,50	9,5	A
9,51-10,0	10	

Failure to attend the examination without reason is recorded as "absent" and is equivalent to 0 (zero). The student is entitled to 2 repeated claims of the unsuccessful exam.

X. RECOMMENDED BIBLIOGRAPHY

A. Mandatory:

1. Materialele cursurilor.
2. Nacu V., Lăbușca L. Medicina regenerativă și nanomedicina. 2021, Chișinău, „Tipografia –Sirius”. 200 p.
3. Ababai I., Ciobanu P., Ghidirim Gh., Nacu V., Sroit I. Optimizarea regenerării reparatorii a tesuturilor și imunogenezei locale în contextul funcționării nanosistemelor naturale. Chisinau. „Tipografia centrala”, 2011, 336p.
4. Ravi Birla Introduction to Tissue Engineering (eBook, PDF) Applications and Challenges. 317p.
5. Gross BC, Erkal JL, Lockwood SY, et al. Evaluation of 3D printing and its potential impact on biotechnology and the chemical sciences. Anal Chem. 2014;86(7):3240–3253.
6. Ulrich Meyer, Jörg Handschel, Hans Peter Wiesmann, Thomas Meyer Fundamentals of Tissue Engineering and Regenerative Medicine, 2009, Springer, Berlin, Heidelberg, 557p. DOI <https://doi.org/10.1007/978-3-540-77755-7>

B. Supplemental:



CD 8.5.1 CURRICULUM DISCIPLINĂ

Redacția: 09

Data: 08.09.2021

Pag. 8/8

1. Ababii I., Nacu V., Friptu V., Ciobanu P., Nacu L., Revencu T. Ghid practic de prelevare a sângelui ombilicoplacentar. Chișinău, 2008, 36 p.
2. Nacu V. Optimizarea regenerării osoase posttraumatice dereglate. Chișinău: "Tipografia - Sirius", 2010. 188 p.
3. Vacanti C.A., Biological Matrices and Tissue Reconstruction, Verlag, Berlin Heidelberg, VI-VII, 1998:
4. Stein H., Rozen N., Kaufmann H., Lerner A., Adult somatic stem cells and the musculoskeletal system, Orthopedics, Vol 29, Nr. 5, 418-421, 2006:
5. Bionest Partners, Cell therapy and tissue engineering study, february 2007; Luyten F.P., Del'Accio F., Bari C.,
6. Faulkner A., Geesink L., Kent J., Fitzpatrick D., Human tissue engineered products, drugs or devices?, BMJ 326:1159-1160 (31 May), doi: 10.1136/bmj. 2003:
7. Regenerative Medicine. 2006. Department of Health and Human Services & National Institutes of Health, USA.
8. Imayoshi, I. et al., Roles of continuous neurogenesis in the structural and functional integrity of the adult forebrain. Nat Neurosci. 2008. 11(10): p. 1153-61.
9. Mason, C. and P. Dunnill, A brief definition of regenerative medicine. Regen Med. 2008. 3(1): p. 1-5.
10. Greenwood, H.L., et al., Regenerative medicine and the developing world. PLoS Med. 2006. 3(9): p. e381.